Gidon and Segev *BMC Neuroscience* 2011, **12**(Suppl 1):P291
http://www.biomedcentral.com/1471-2202/12/S1/P291

BMC Neuroscience

POSTER PRESENTATION Open Access

Inhibitory coverage of dendritic excitation

Albert Gidon[1*], Idan Segev[1,2,3]

From Twentieth Annual Computational Neuroscience Meeting: CNS*2011
Stockholm, Sweden. 23-28 July 2011

"The Coverage Problem" is a class of optimization problems used in different fields that aims to explore the best strategy in order to maximally "cover" a region under some constrains. For example, how could a limited number of cellular antennas be distributed such that their signals would cover a maximal region (e.g., a whole city) while limiting the radio-frequency radiation to safe levels? Here we ask whether the notion of coverage could be applied to inhibitory synapses, giving them optimal control over the excitatory/excitable activity in the dendritic tree. In support of this idea is the fact that most (85%) [1-3] inhibitory synapses target dendrites rather than operate at the soma/axon region as a global veto mechanism of the neuron's output . Additionally, it seems to be the rule rather than the exception that single inhibitory axons target specific dendritic sub-regions where each axon makes multiple synapses [4-6], implying that the role of such inhibition is to cover a particular dendritic region. Using analytic solutions of the cable theory as well as detailed compartmental models, we searched for the spatial distribution of inhibition that maximally covers the modeled dendrite under different constraints (e.g., fixed number of contacts per axon and fixed total inhibitory conductance). We explored the conditions in which the inhibitory coverage would be most effective in controlling the neuronal output and compared our results to the actual distributions of inhibitory synapses in different dendrites. We showed that despite the small number of inhibitory synapses (relative to the excitatory synapses) in dendrites of most central neurons, when the synapses are strategically placed, they can effectively dampen the excitatory/excitability activity in dendrites both globally and in a domain-specific manner.

* Correspondence: agidon20@gmail.com
[1]Department of Neurobiology, The Hebrew University of Jerusalem, Israel
Full list of author information is available at the end of the article

Author details
[1]Department of Neurobiology, The Hebrew University of Jerusalem, Israel. [2]Interdisciplinary Center for Neural Computation, The Hebrew University of Jerusalem, Israel. [3]Edmond and Lily Safra Center for Brain Sciences, The Hebrew University of Jerusalem, Israel.

Published: 18 July 2011

References

1. Beaulieu C, Kisvarday Z, Somogyi P, Cynader M, Cowey A: **Quantitative distribution of GABA-immunopositive and -immunonegative neurons and synapses in the monkey striate cortex (area 17).** *Cereb. Cortex* 1992, **2**:295-309.
2. Beaulieu C, Somogyi P: **Targets and Quantitative Distribution of GABAergic Synapses in the Visual Cortex of the Cat.** *Eur. J. Neurosci* 1990, **2**:296-303.
3. Liu G: **Local structural balance and functional interaction of excitatory and inhibitory synapses in hippocampal dendrites.** *Nat. Neurosci* 2004, **7**:373-379.
4. Markram H, Toledo-Rodriguez M, Wang Y, Gupta A, Silberberg G, Wu C: **Interneurons of the neocortical inhibitory system.** *Nat. Rev. Neurosci* 2004, **5**:793-807.
5. Klausberger T, Somogyi P: **Neuronal diversity and temporal dynamics: the unity of hippocampal circuit operations.** *Science* 2008, **321**:53-57.
6. Douglas RJ, Martin KA: **Inhibition in cortical circuits.** *Curr. Biol* 2009, **19**: R398-402.

doi:10.1186/1471-2202-12-S1-P291
Cite this article as: Gidon and Segev: Inhibitory coverage of dendritic excitation. *BMC Neuroscience* 2011 **12**(Suppl 1):P291.